A satellite view of the Earth, showing the Gulf of Mexico and the surrounding landmasses, including North and South America. The image is positioned on the left side of the slide, with a grid pattern overlaid on the background.

**Comparison of Fluid Prediction Success
between AVO and Bright Spot
Techniques in the Marco Polo Field,
the Gulf of Mexico.**

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Statement of Problems

- Bright spot amplitude often misleads the fluid-type interpretation
- AVO analysis extracts rock physics information which the bright spot technique does not do.
- This study utilized AVO techniques as a mean to correct fluid-type misinterpretation from the bright spot method.

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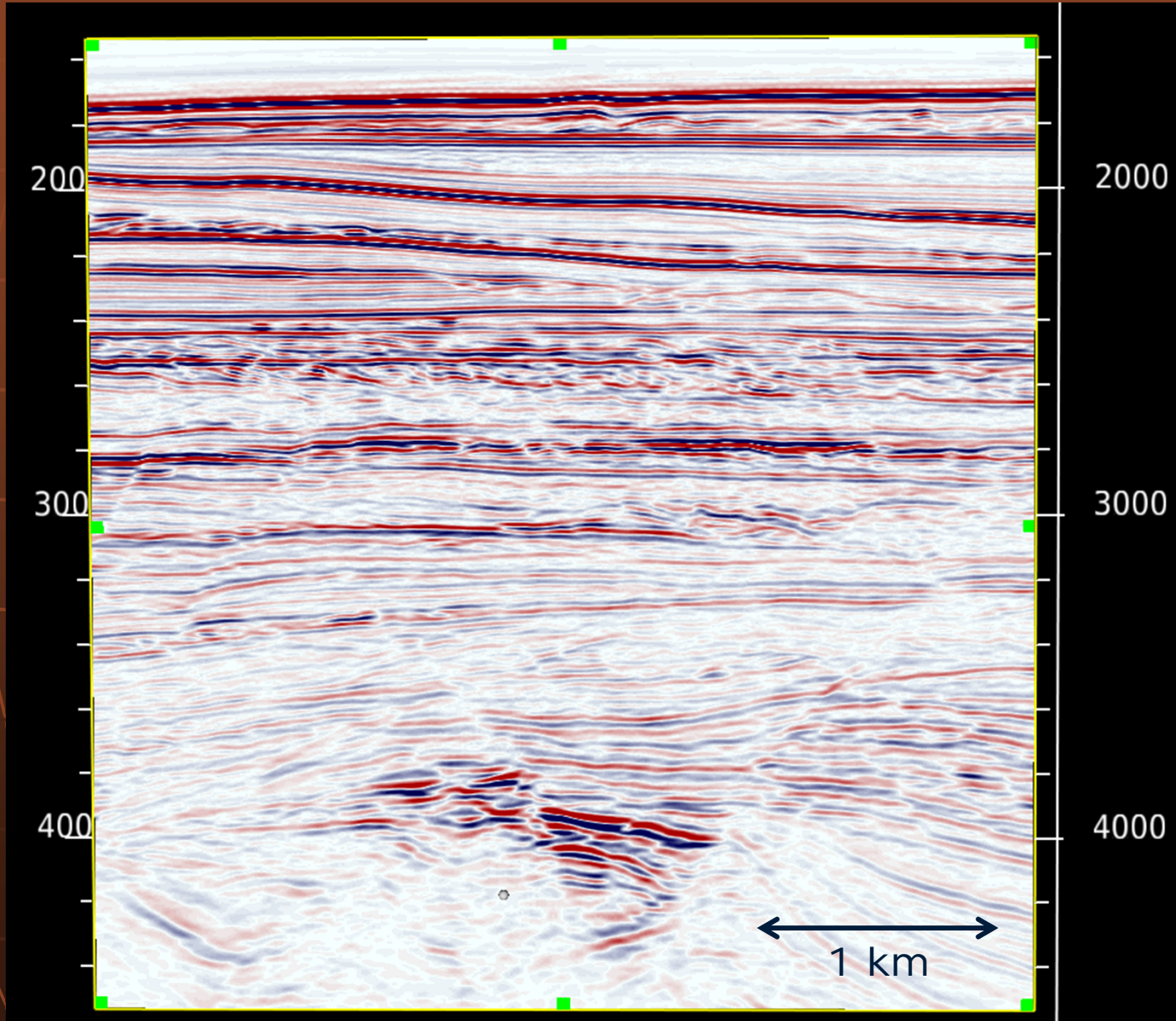
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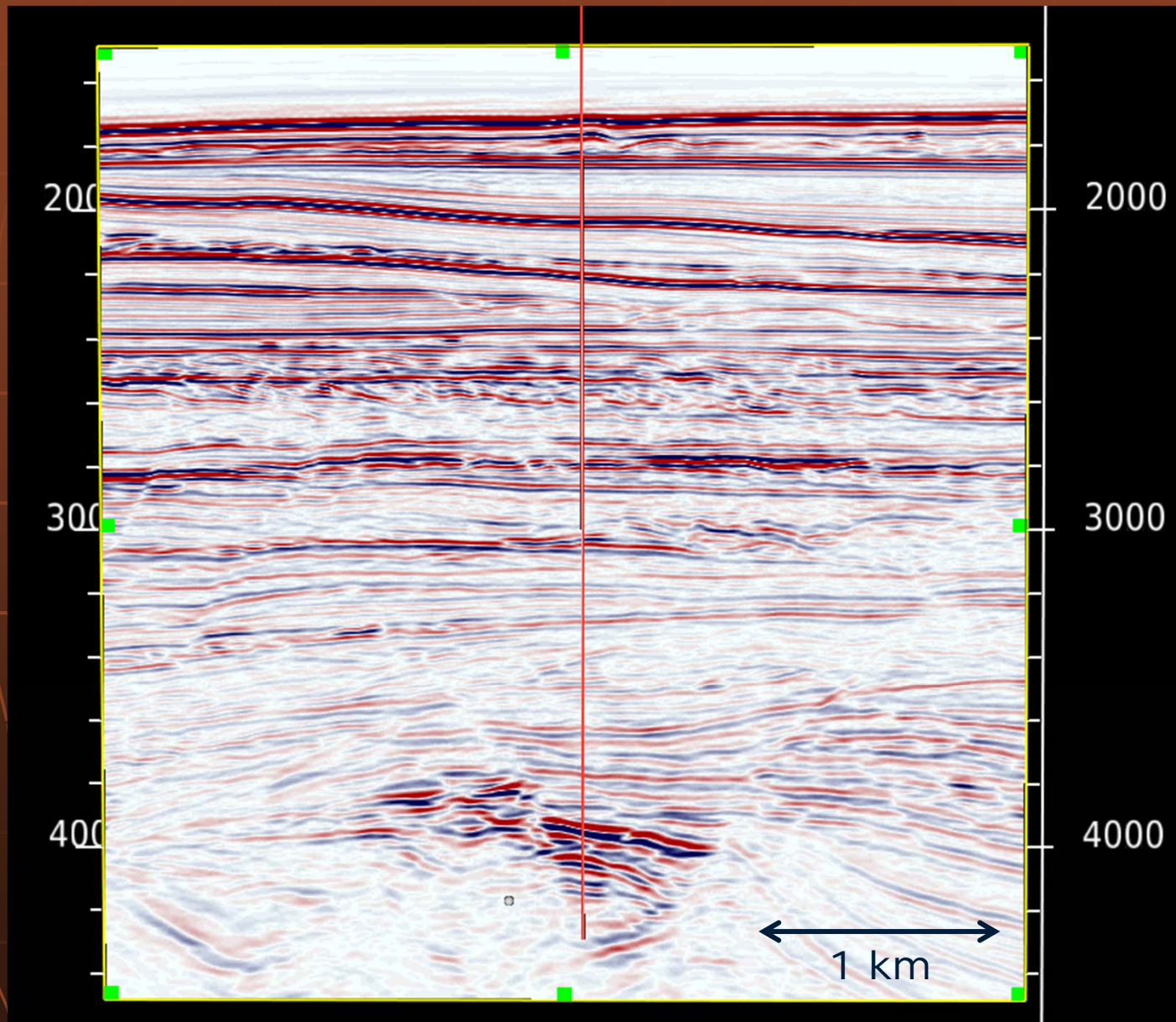
Location of The Marco Polo Field



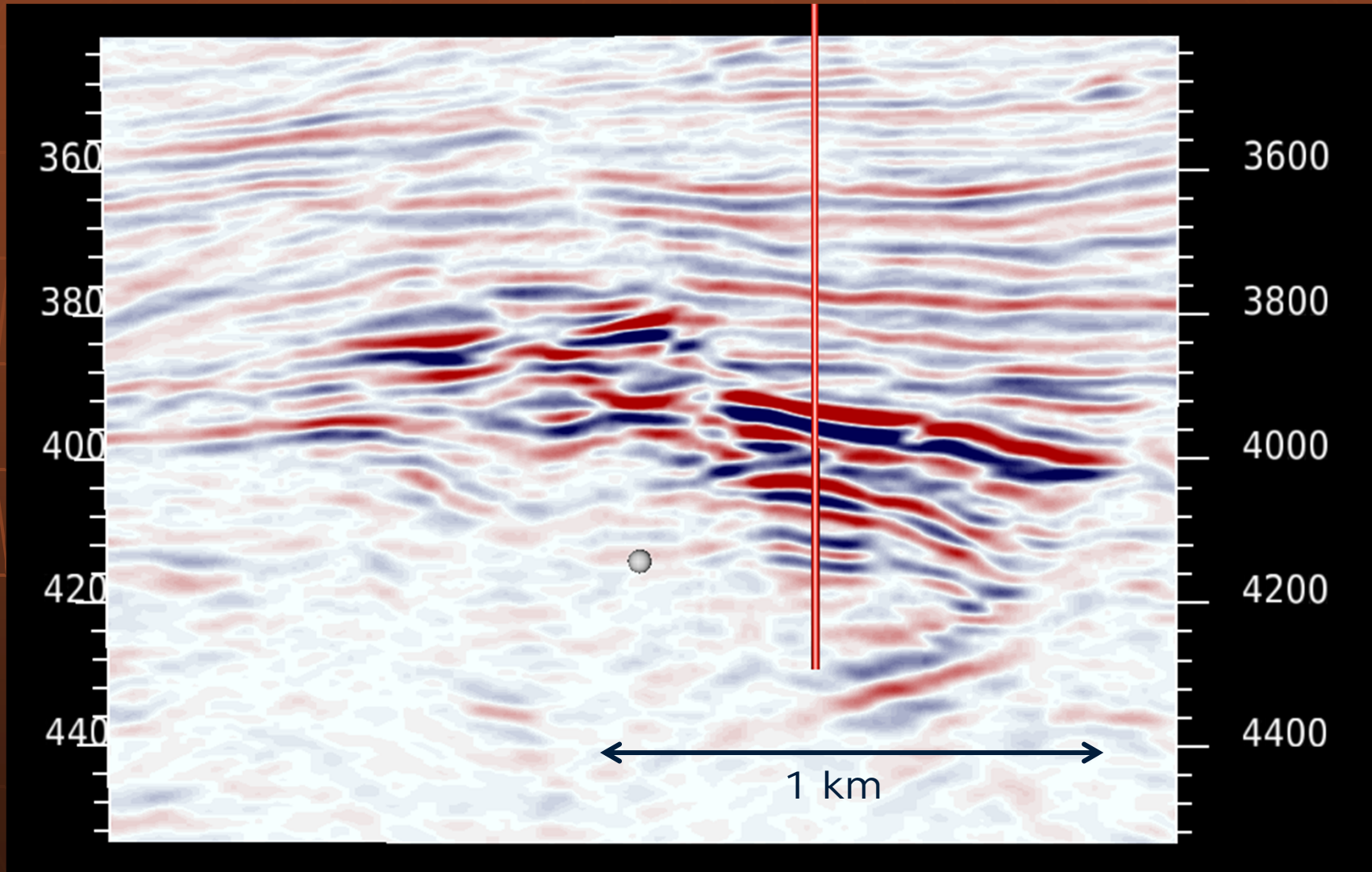
Bright Spots in the Marco Polo Field

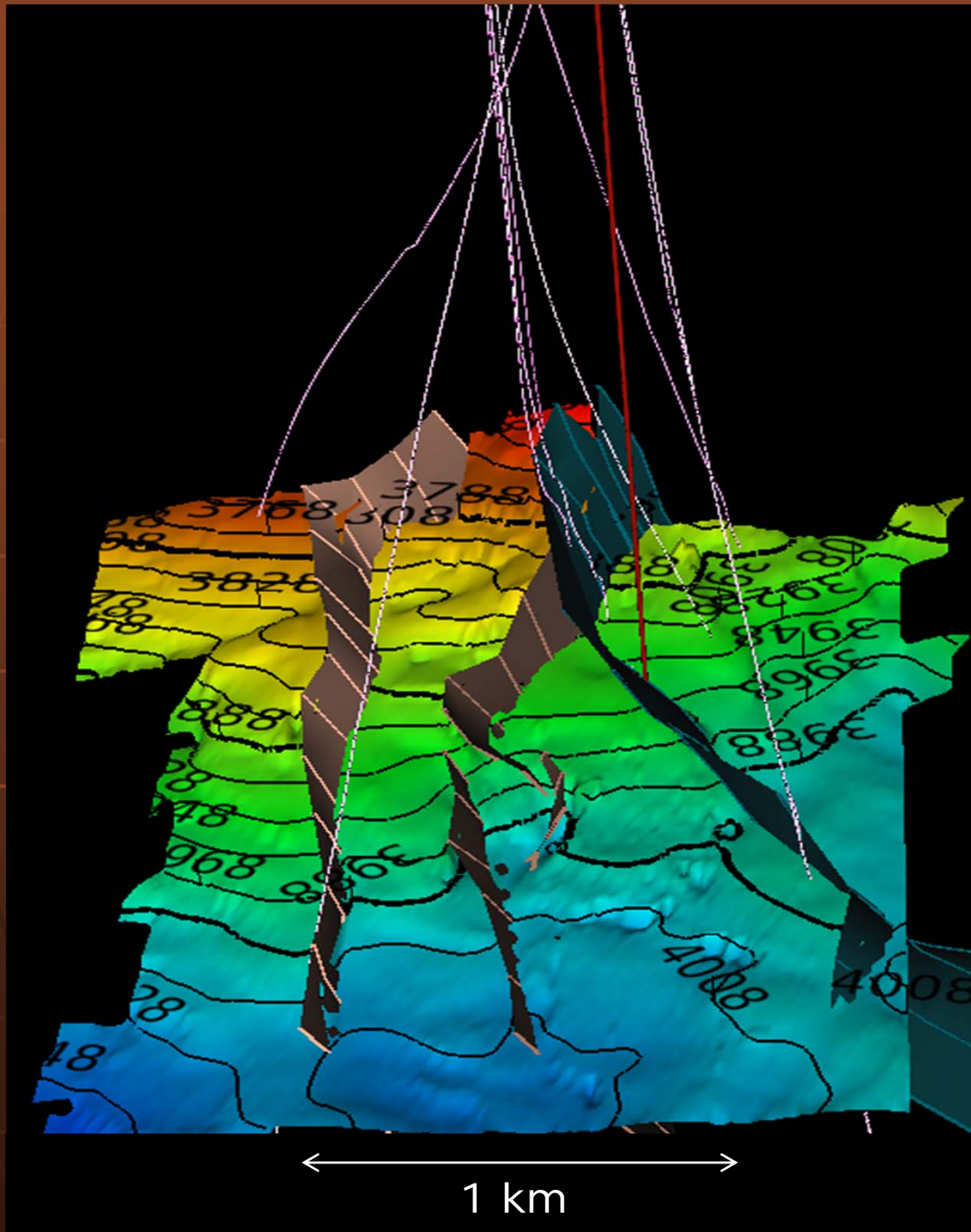


Bright Spots in the Marco Polo Field



Bright Spots and the discovery well





Development wells

- Not all of the bright spots were gas-saturated sands
- Not all of the non-bright spots were brine-saturated sands.

Background Theory

- AVO intercept and gradient

$$R(\theta) = A + B \sin^2 \theta$$

Where

$$A = \frac{1}{2} \left[\frac{\Delta V_p}{V_p} + \frac{\Delta \rho}{\rho} \right] \quad \text{and}$$

$$B = \frac{1}{2} \frac{\Delta V_p}{V_p} - 4 \left[\frac{V_s}{V_p} \right]^2 \frac{\Delta V_s}{V_s} - 2 \left[\frac{V_s}{V_p} \right]^2 \frac{\Delta \rho}{\rho}$$

Generally, gas saturated sands in deep water GOM have class III AVO response on the top interface between shale and capped sands

Theory (con't)

- Elastic Impedance (EI)

$$EI(\theta) = V_p^{(1+\sin^2\theta)} V_s^{(-8K\sin^2\theta)} \rho^{(1-4K\sin^2\theta)}$$

$$\text{Where, } K = \left(\frac{V_s}{V_p}\right)^2$$

Generally, Crossplotting EI for near and far offset allows a greater separation between gas and brine-saturated sands

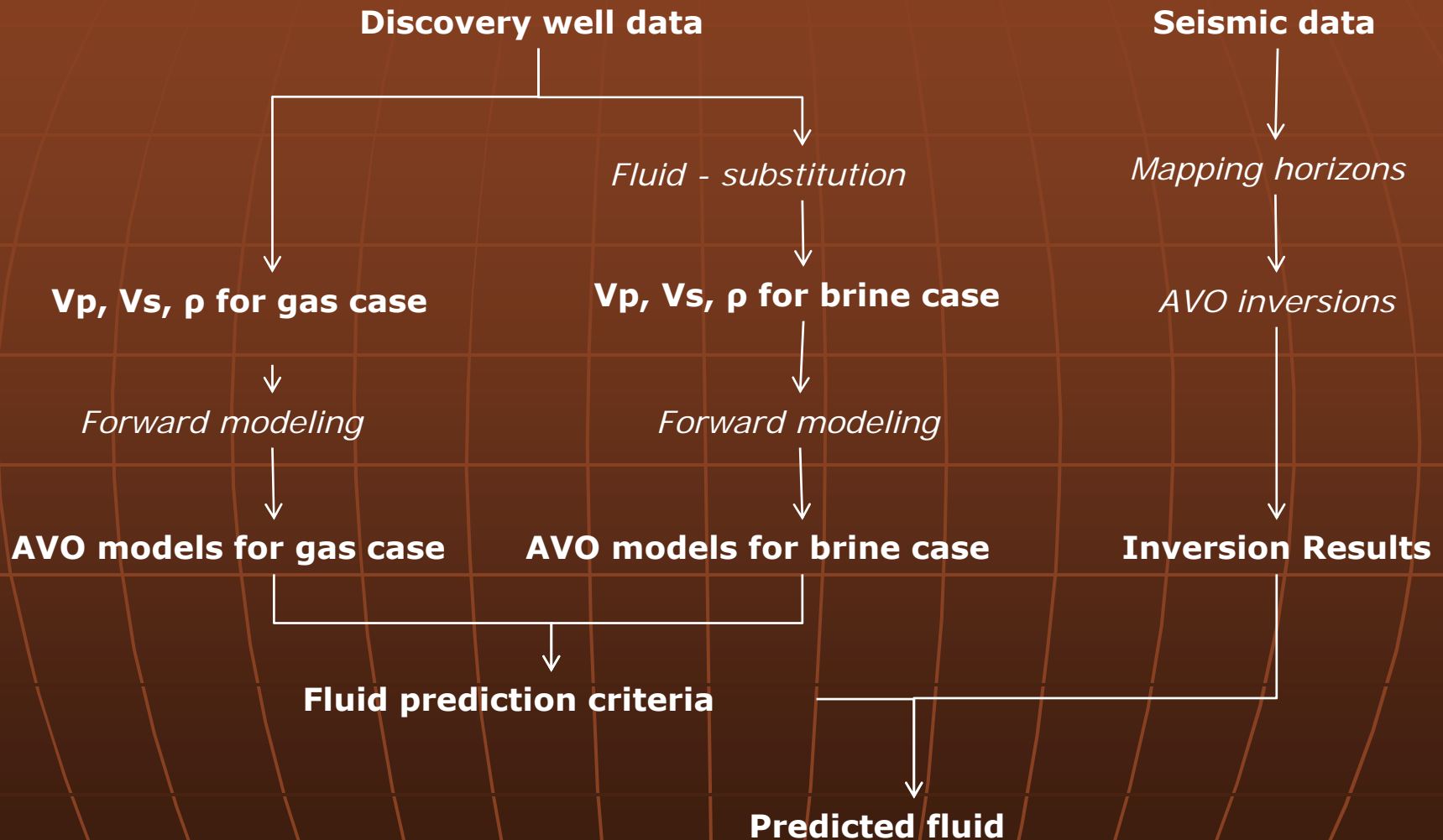
- Lambda Mu Rho (LMR)

$$\mu\rho = Z_s^2 = (\rho V_s)^2$$

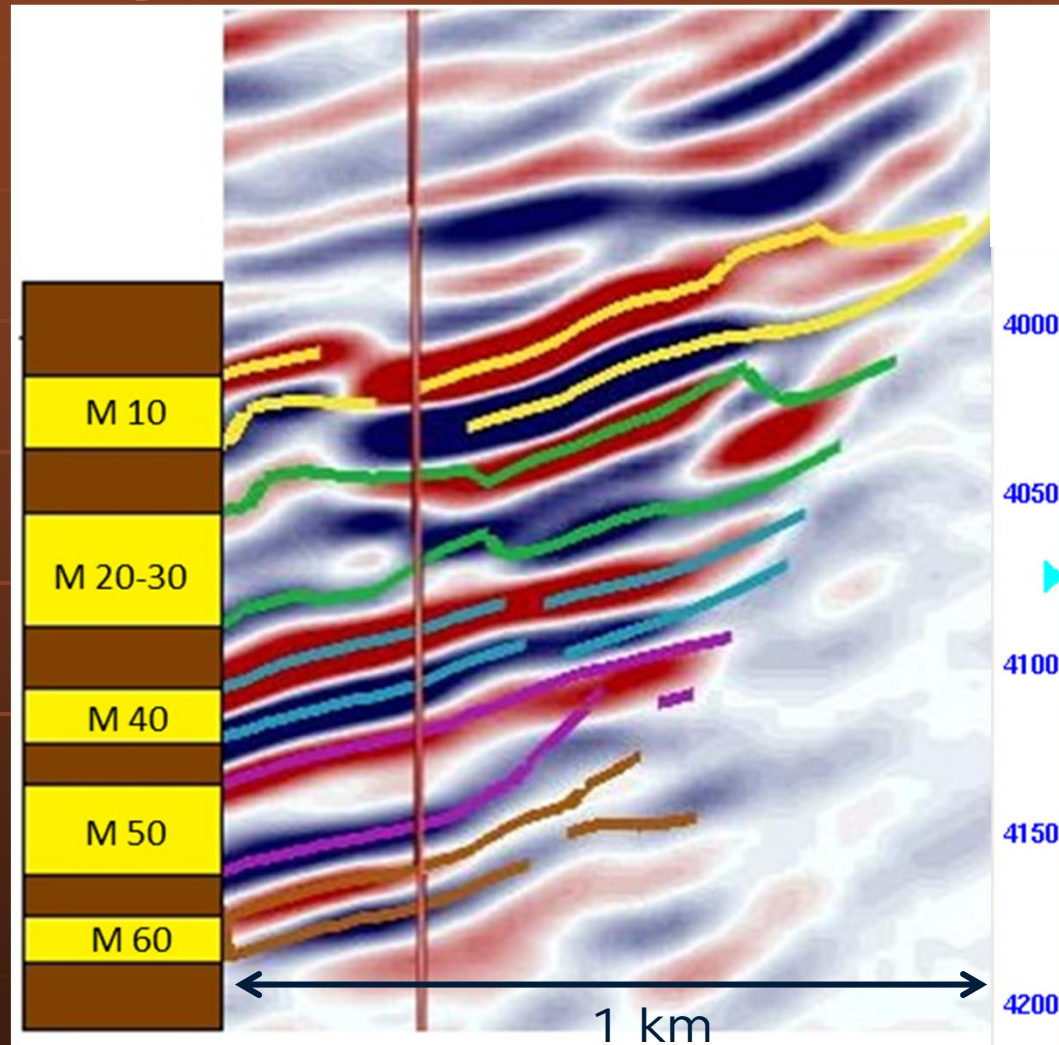
$$\lambda\rho = Z_p^2 - 2Z_s^2 = (\rho V_p)^2 - 2(\rho V_s)^2$$

$\lambda\rho$ is a matrix and fluid indicator, where as
 $\mu\rho$ is mainly an matrix indicator

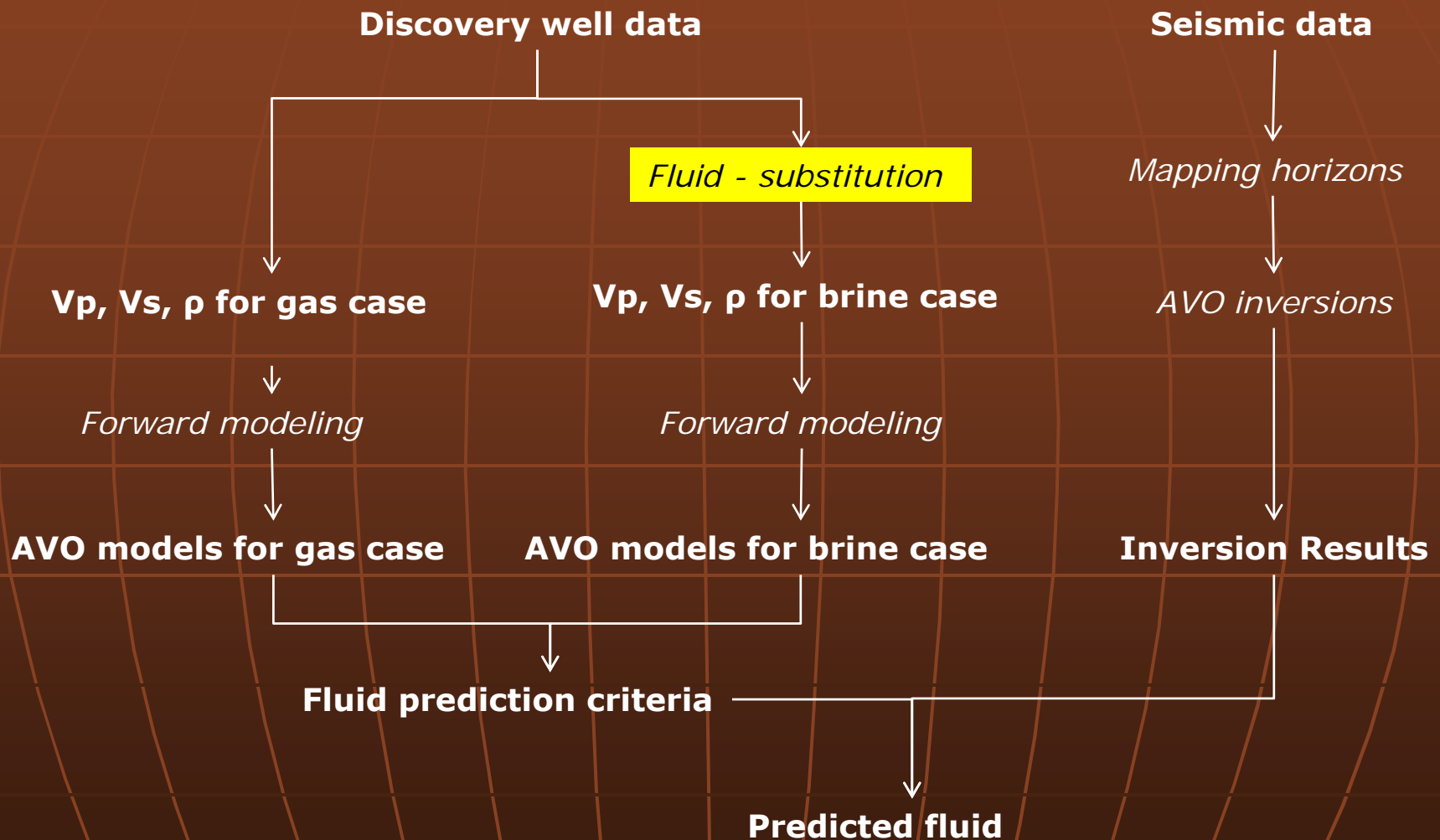
Methodology



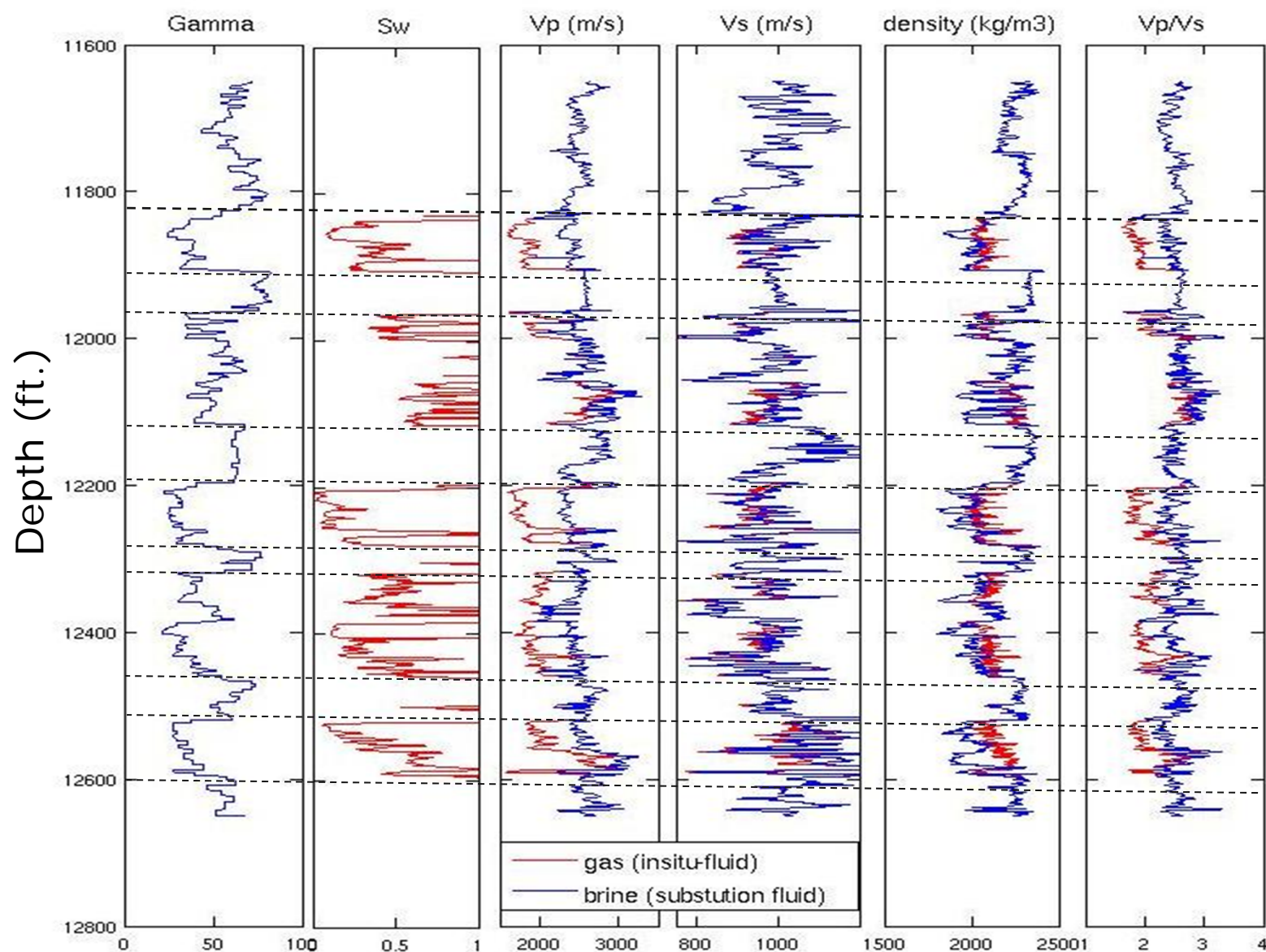
Mapping horizons and faults



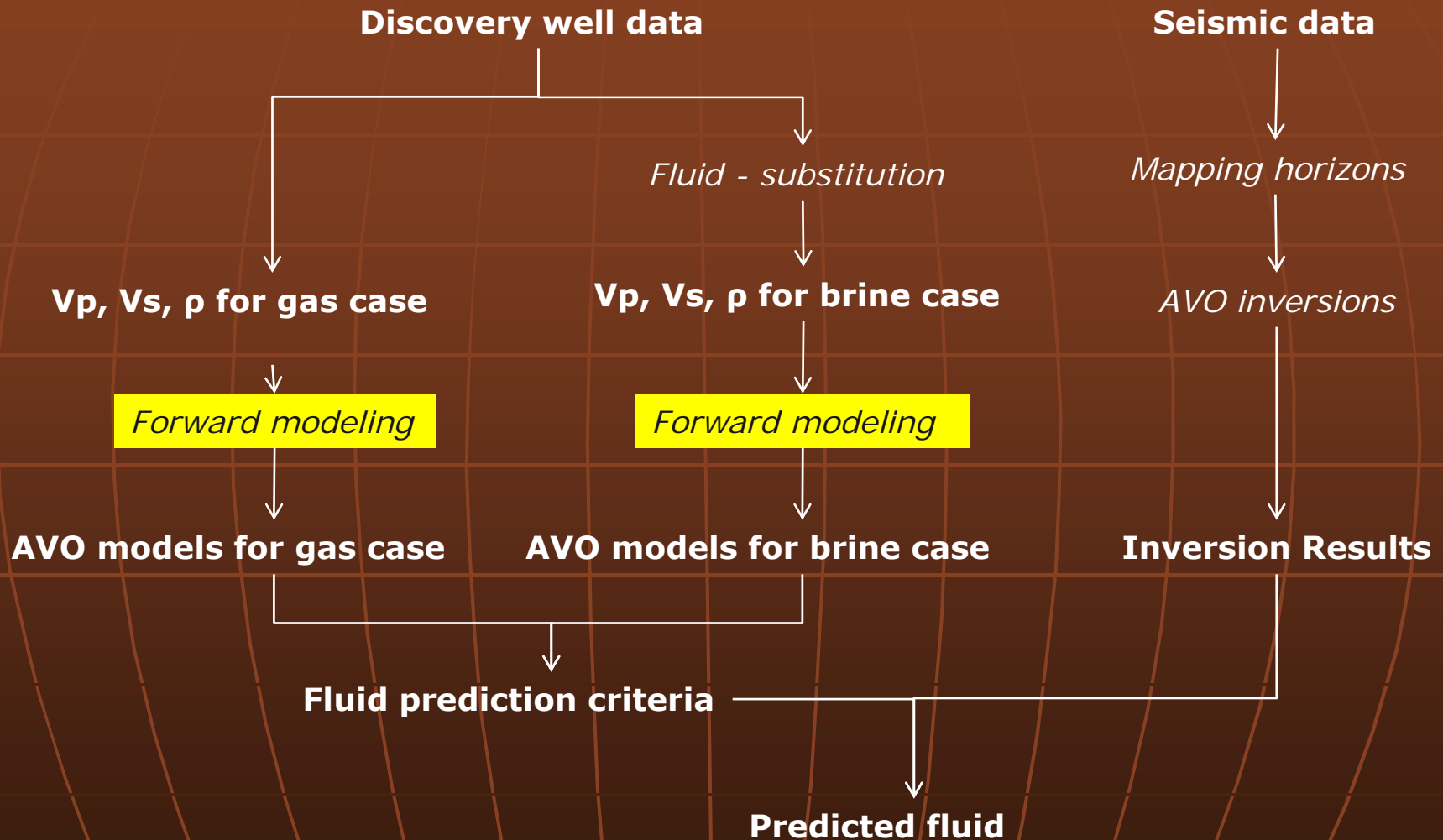
Methodology



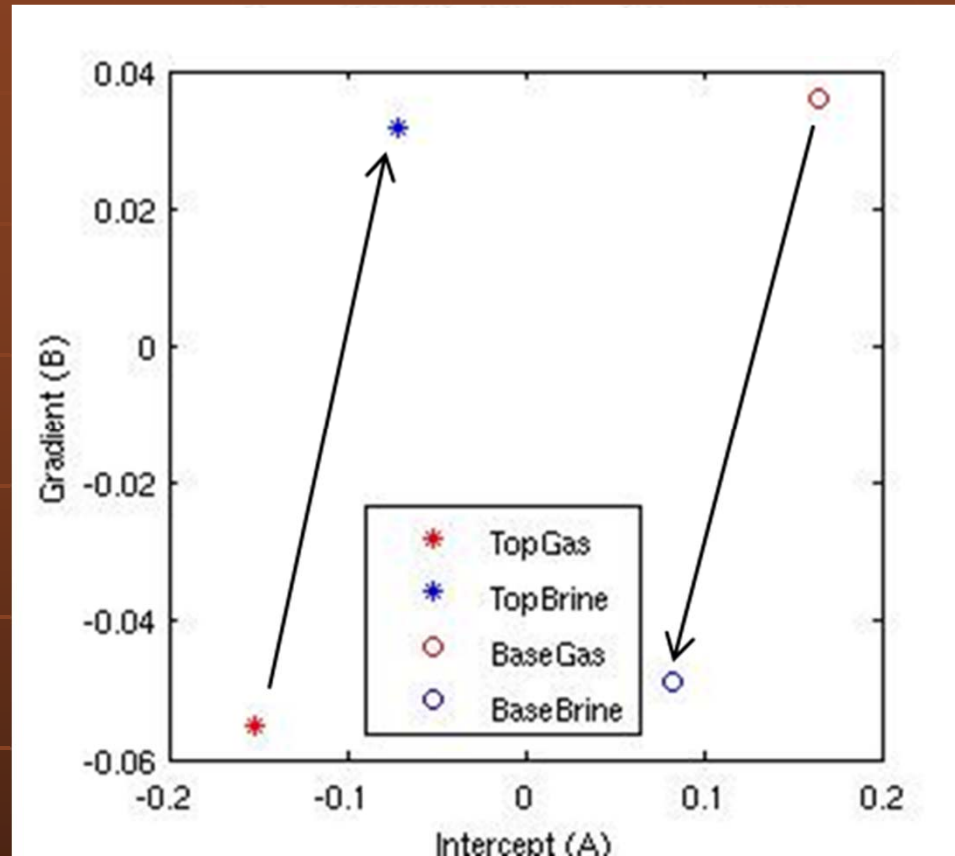
Fluid Substitution Results



Methodology

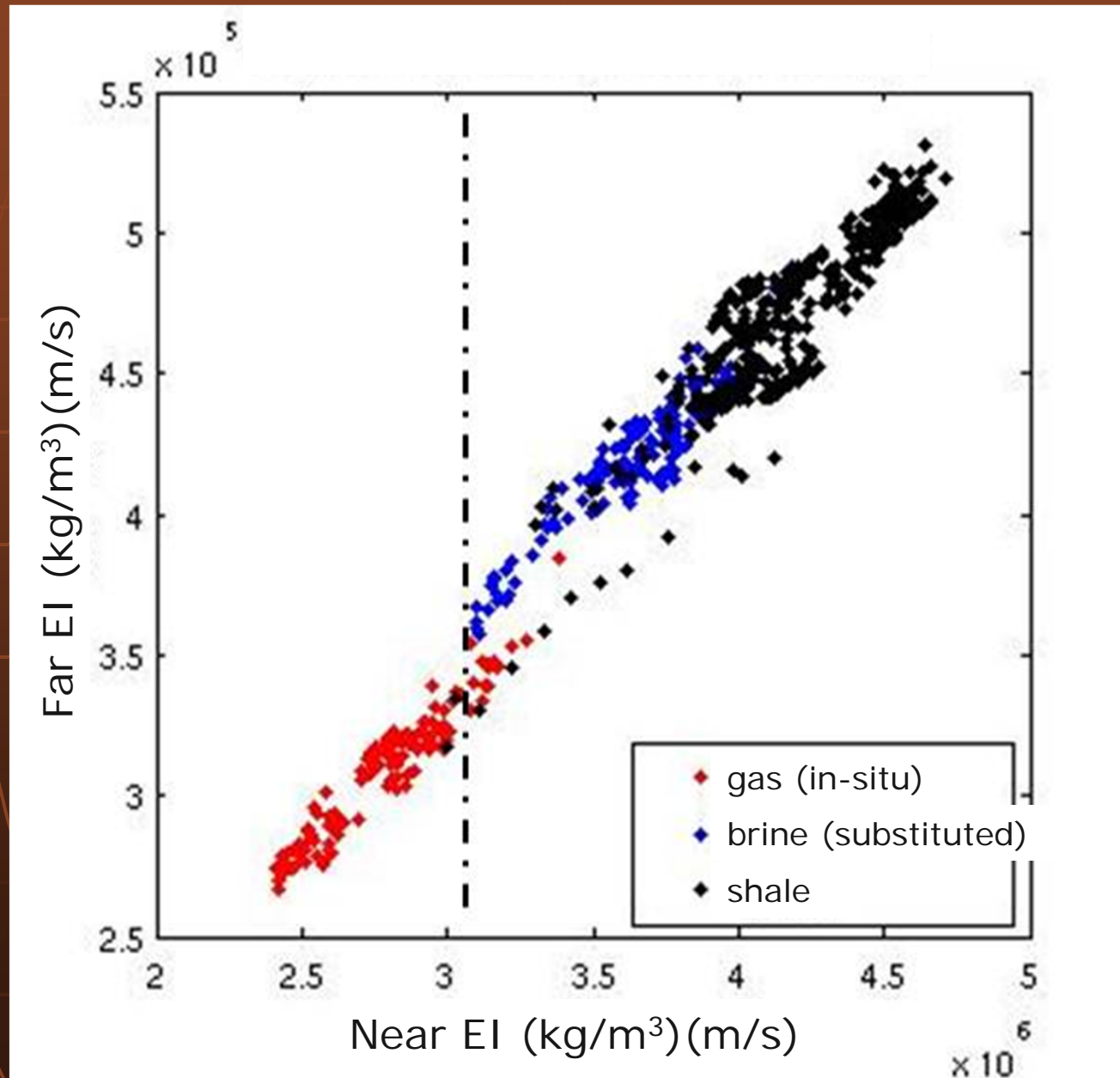


Intercept and Gradient Forward Model

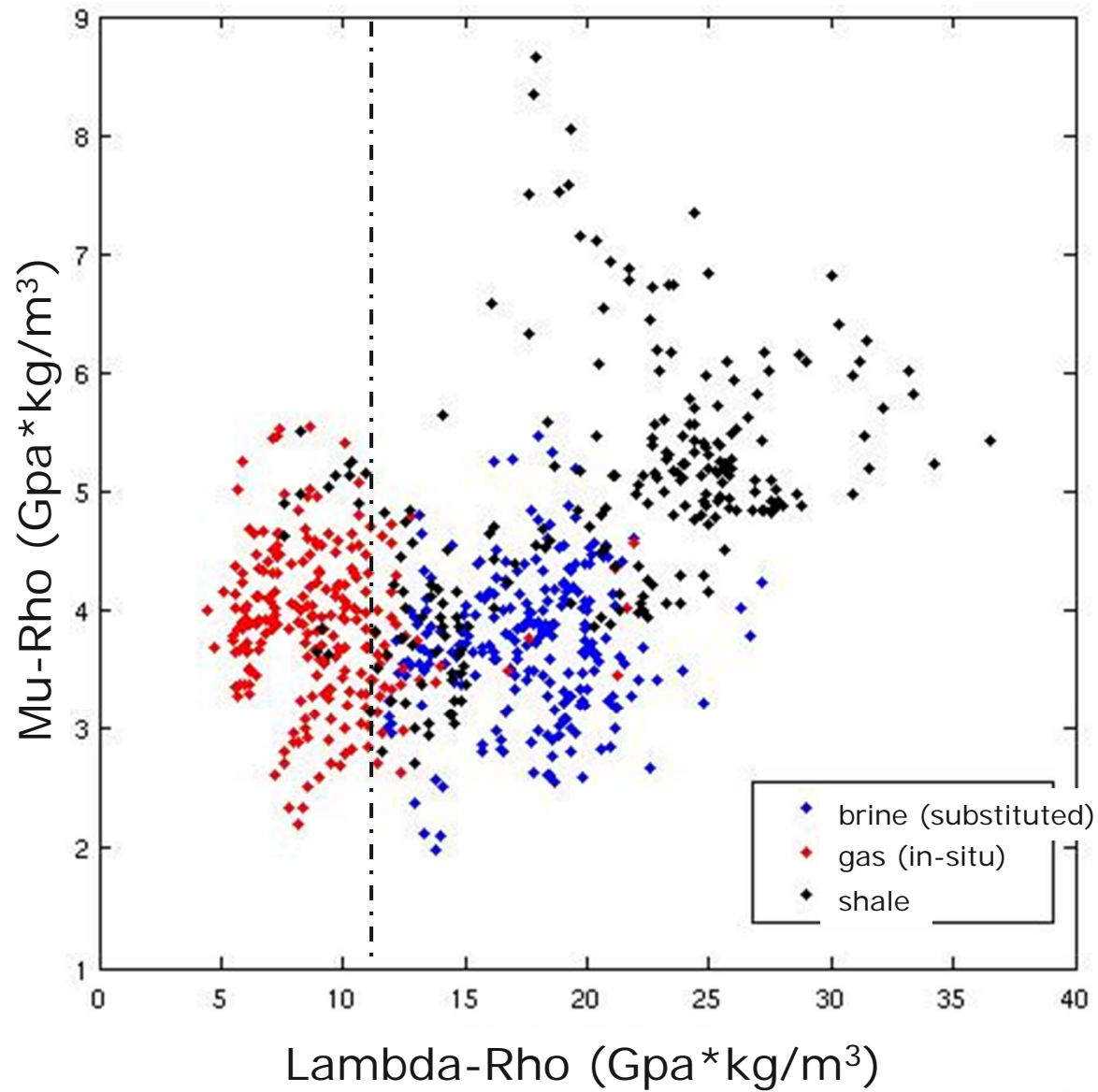


Large negative values of A&B indicated top of gas sands
Large positive values of A&B indicated base of gas sands

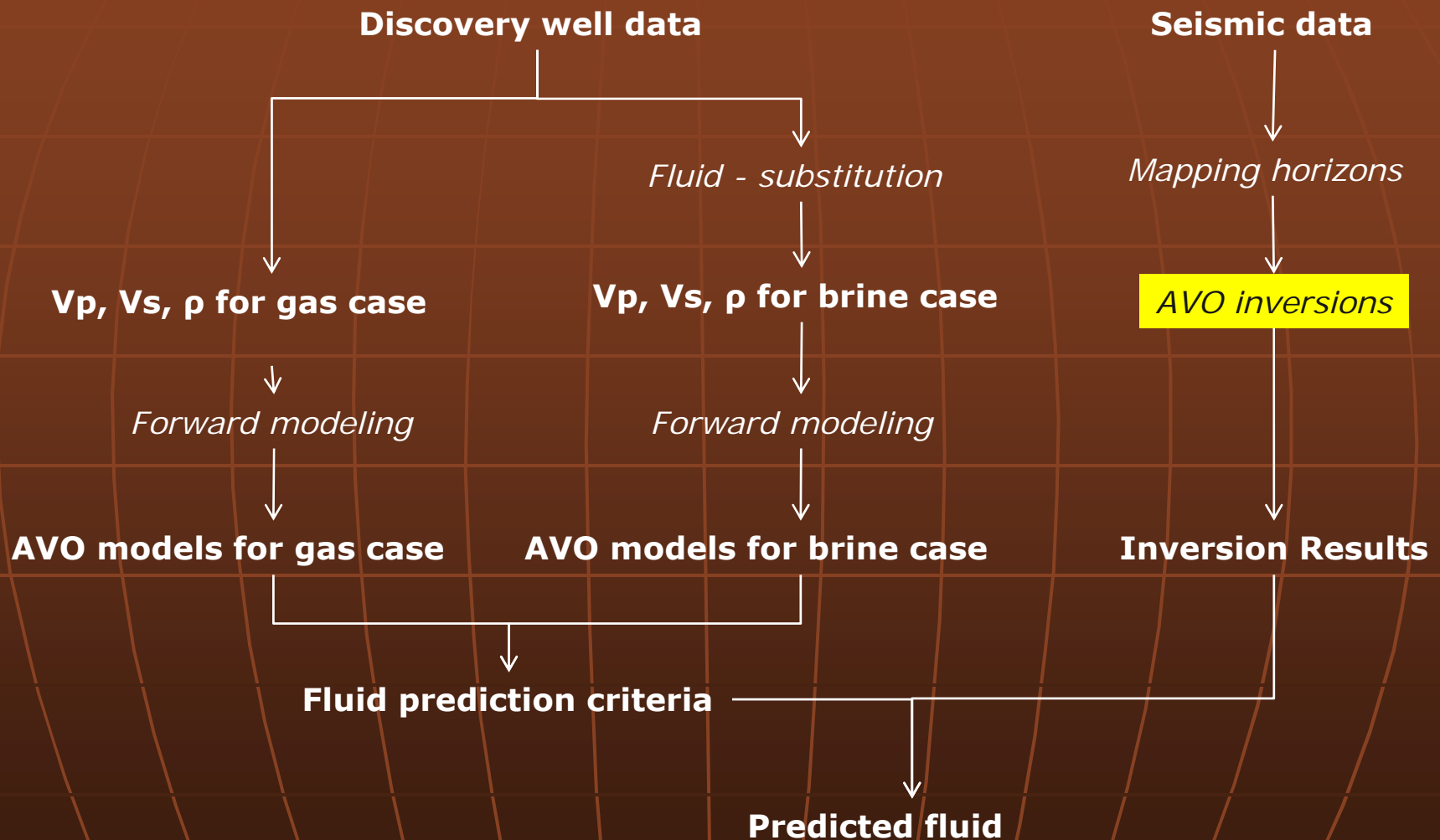
EI Forward Model



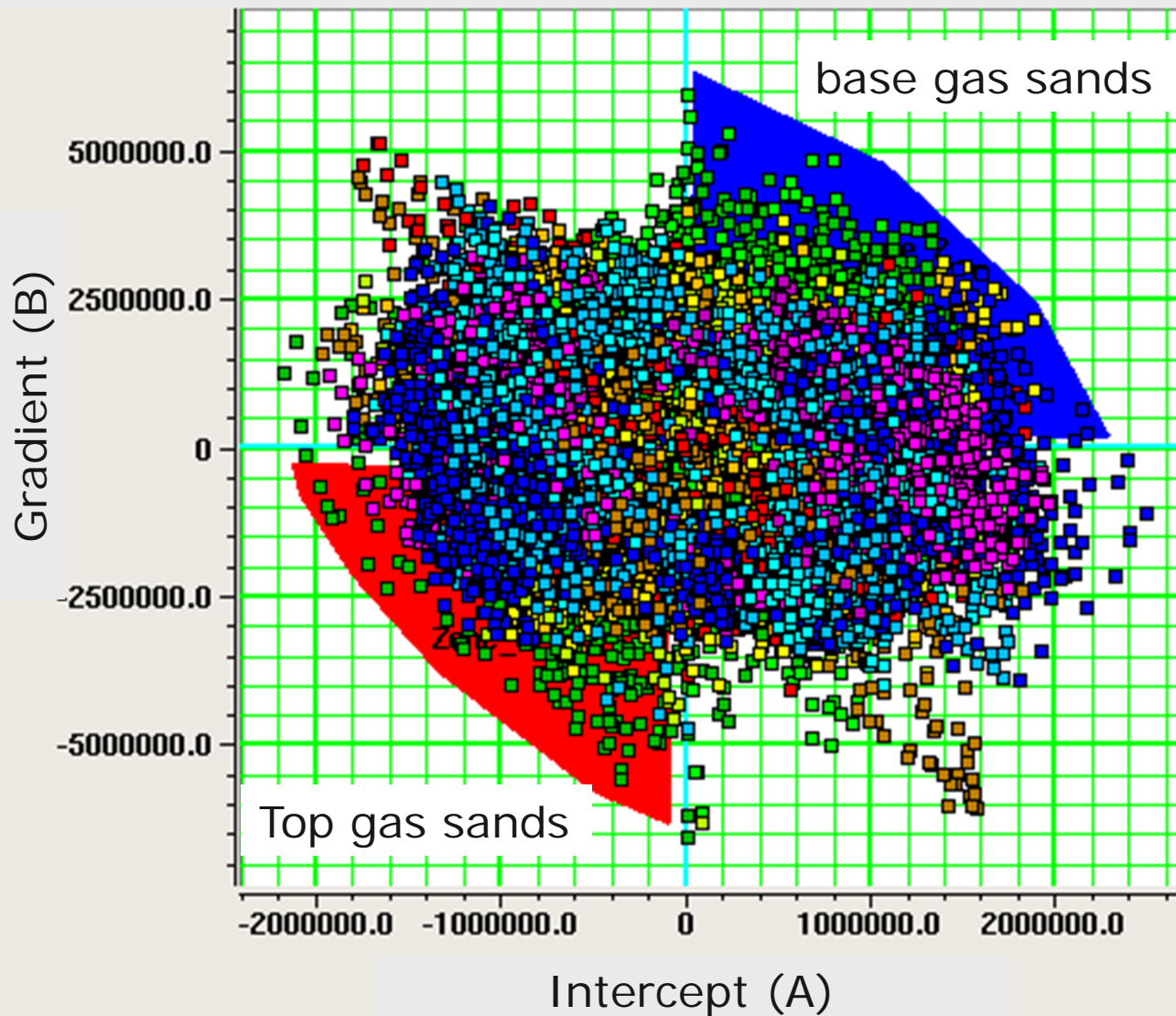
LMR Forward Model



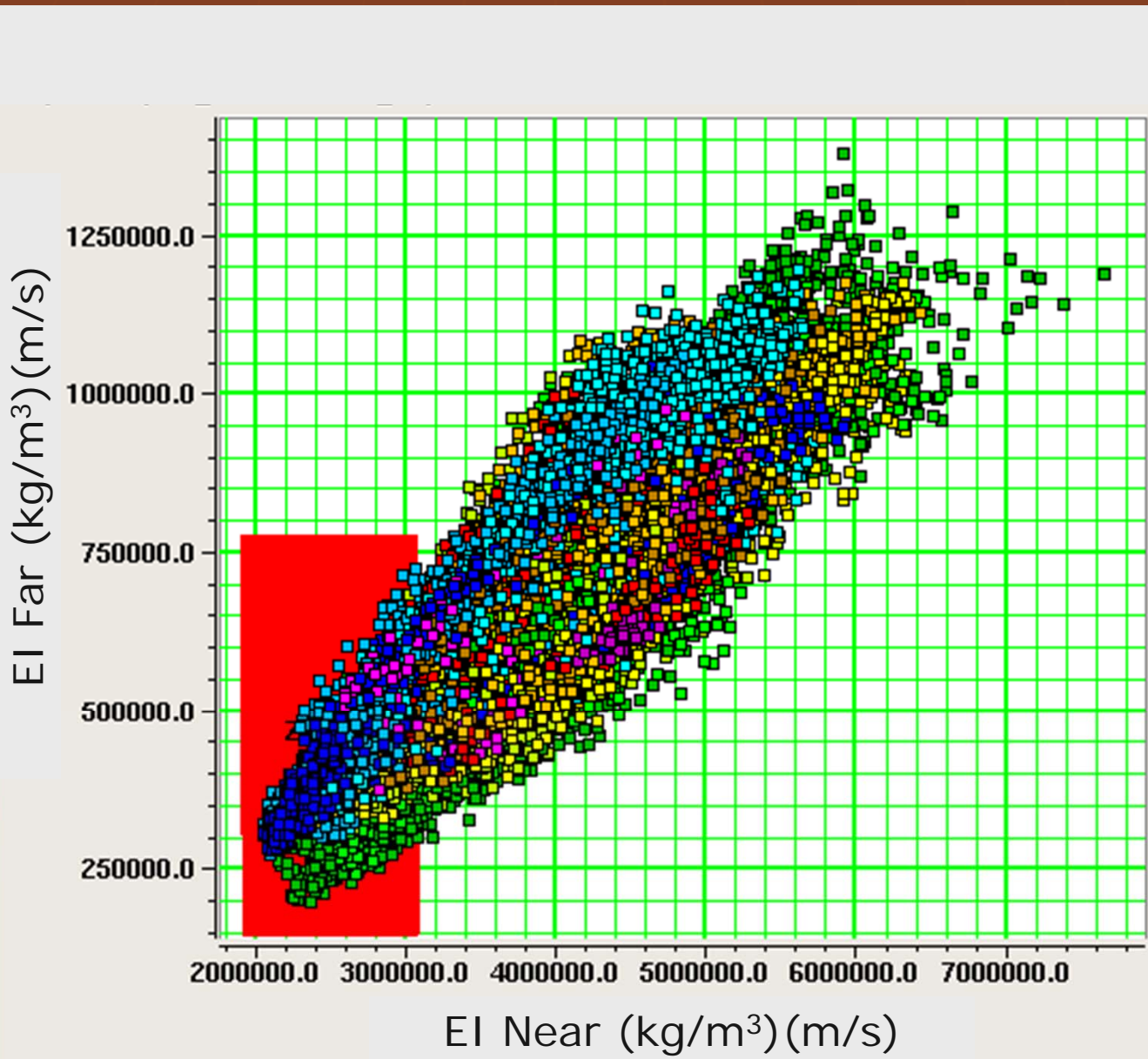
Methodology



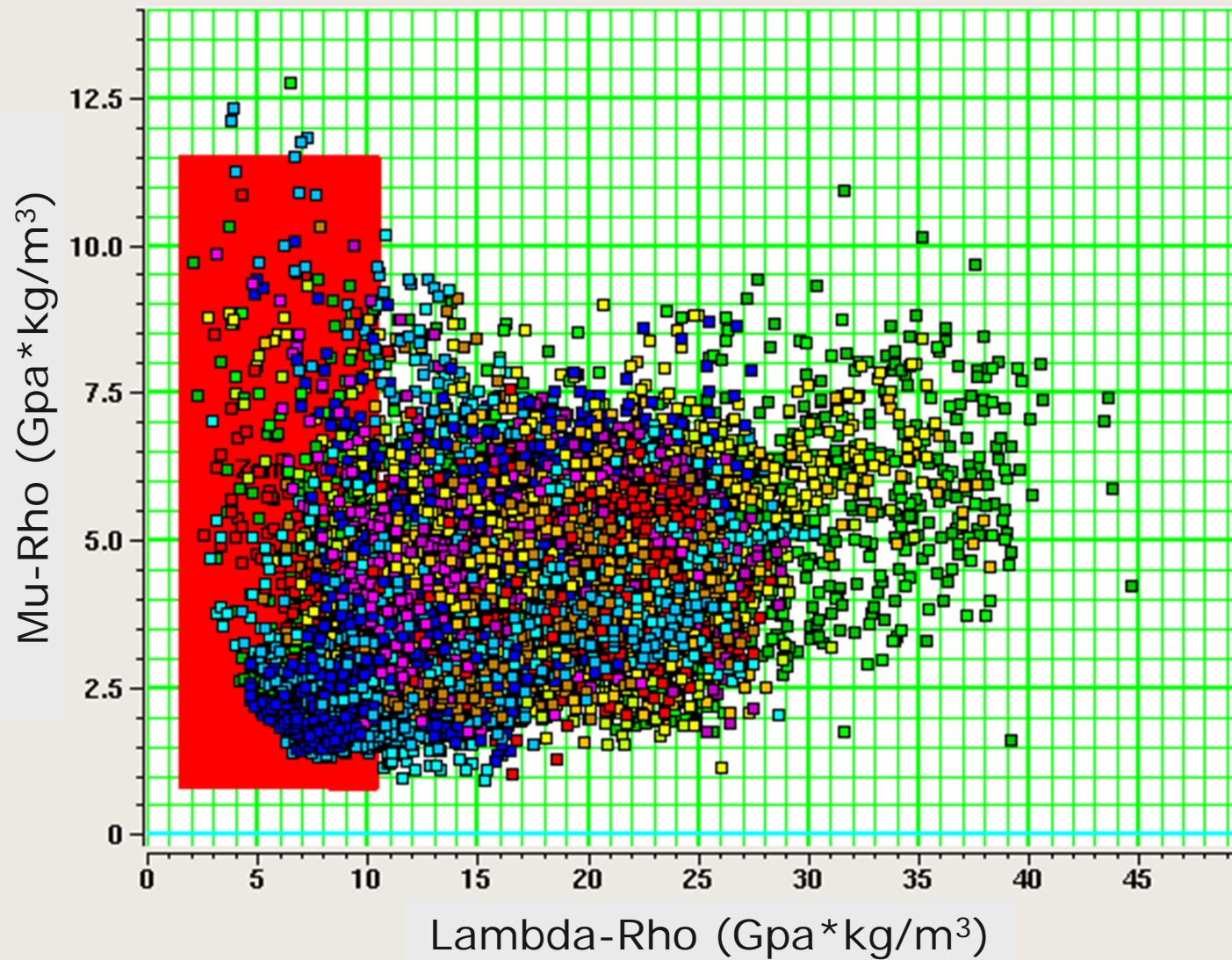
Intercept and Gradient Crossplot



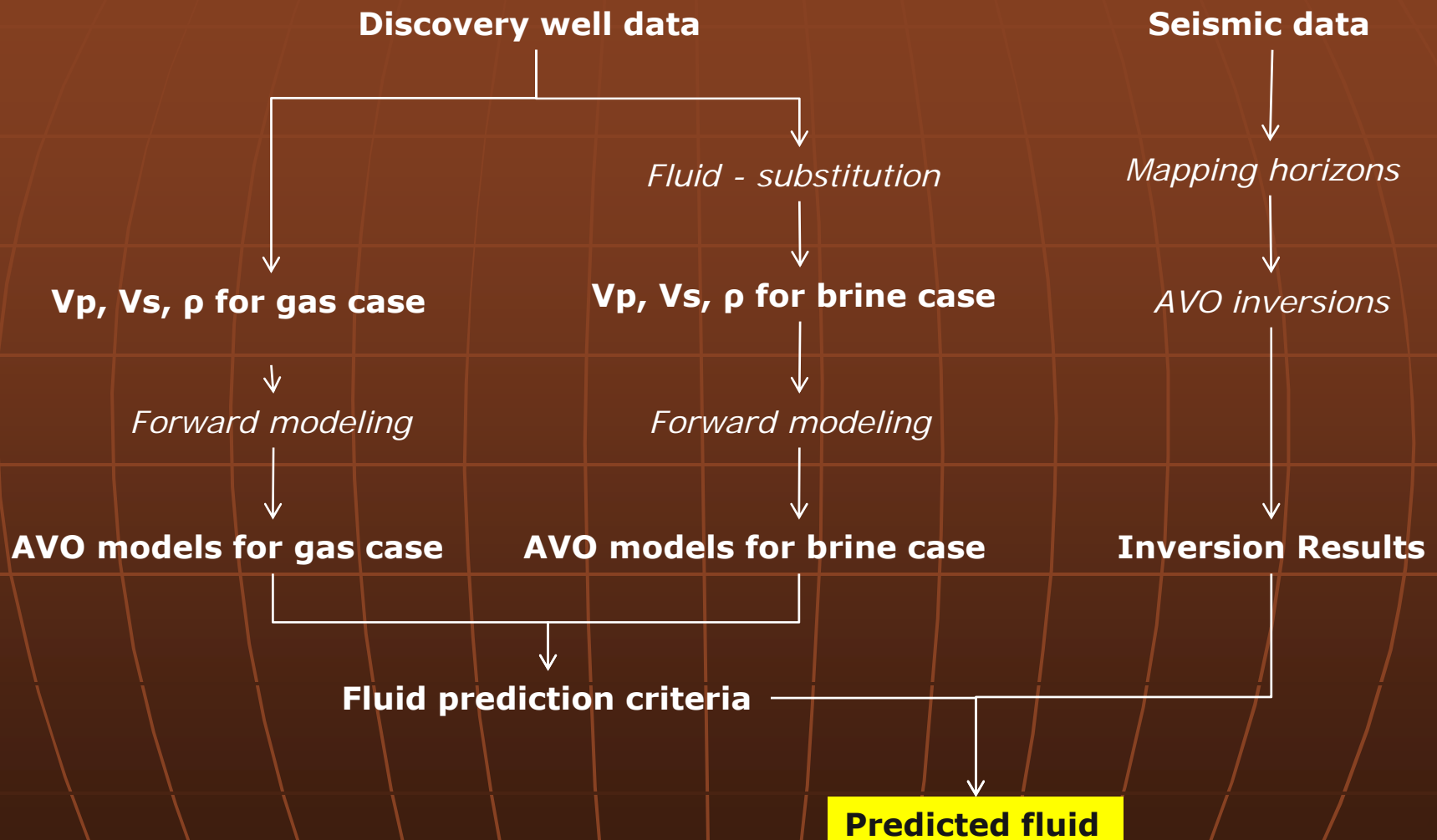
EI Near and Far Offset Crossplot



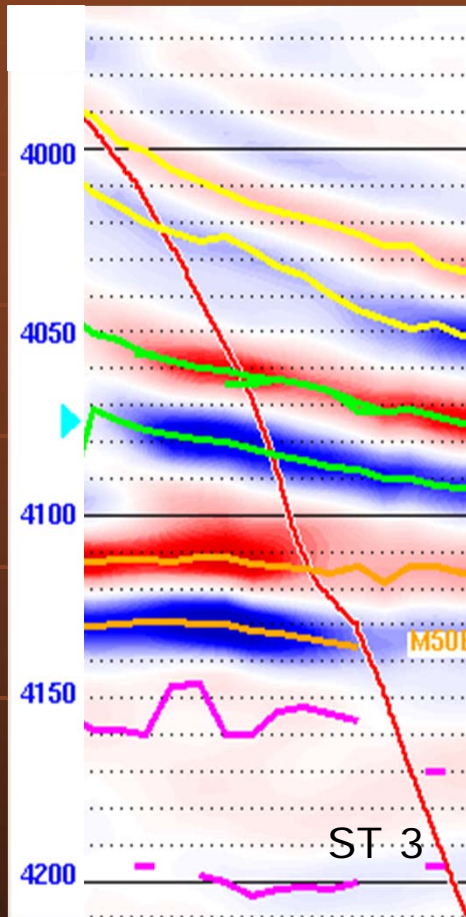
LMR Crossplot



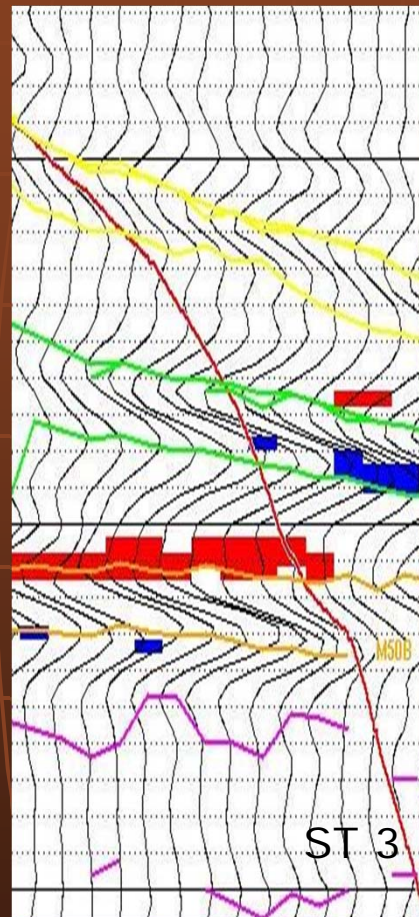
Methodology



Example of Fluid-Type Prediction Results (ST3: wet well)



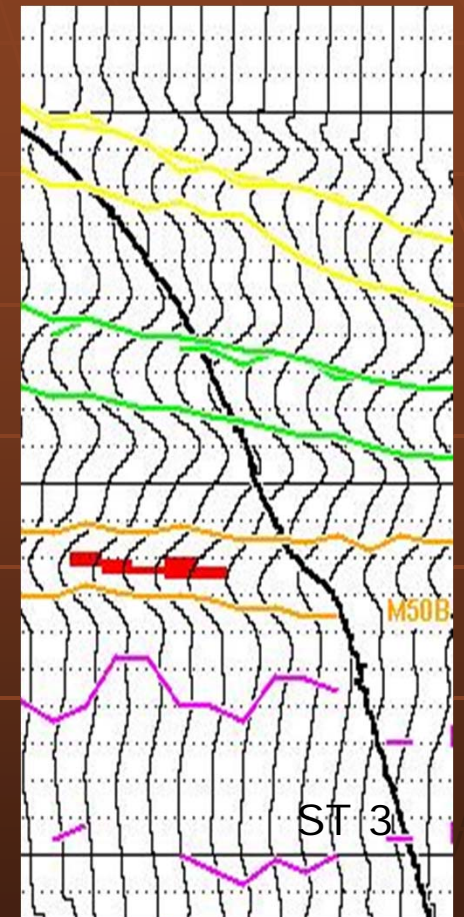
Bright Spots



A & B

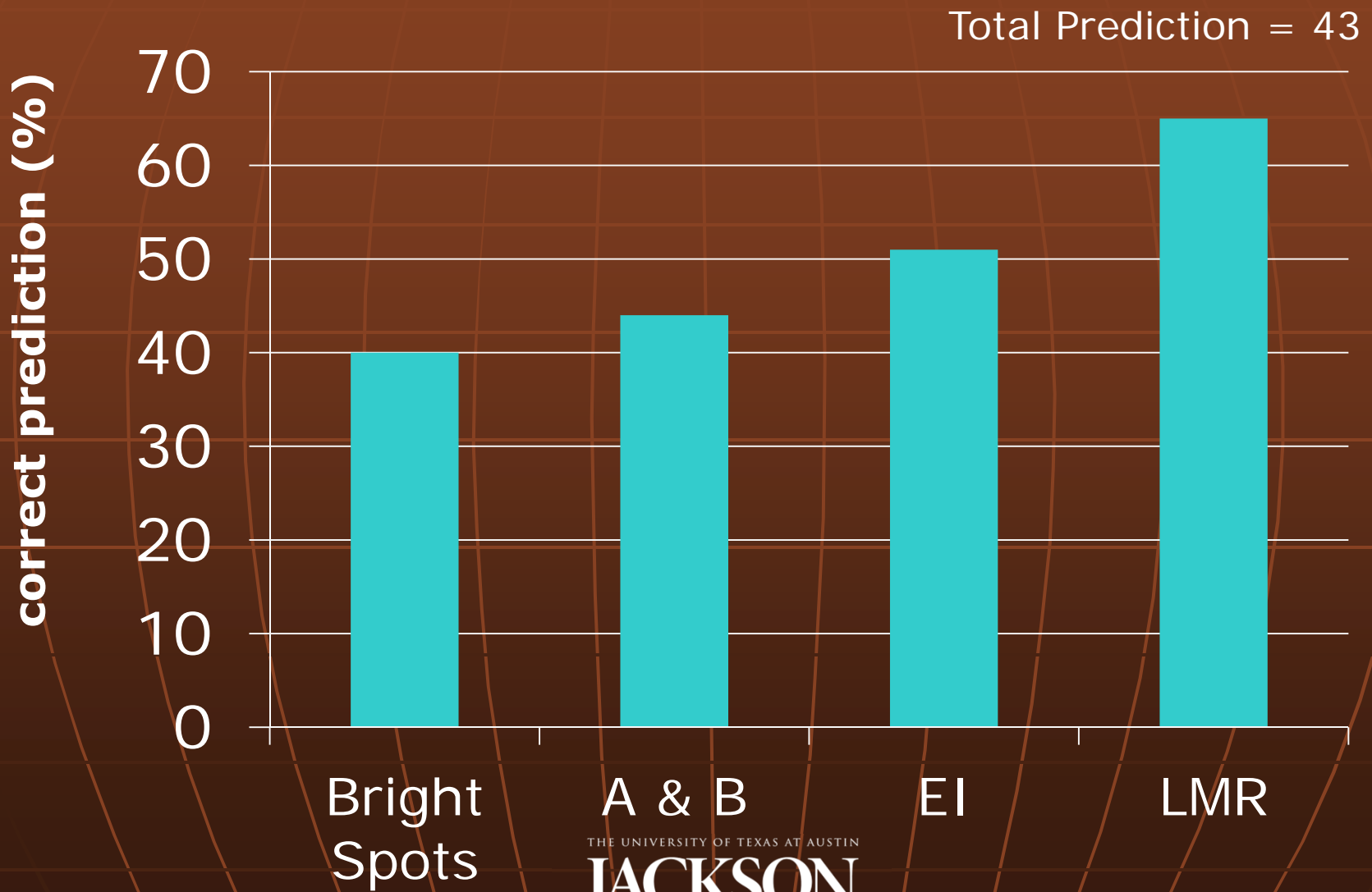


EI



LMR

Percentage of correct fluid-type prediction



Conclusions

- All AVO techniques had superiority in fluid-type prediction than the bright spots method
- The prediction results improved as the computational intensity of the inversion increased from the intercept and gradient, to the elastic impedance, and to the LMR technique.

Acknowledgements

- Dr. Tatham and Dr. Spikes: Project Supervisors
- Dr. Carlson and Dr. Bell: Honor Program Director
- Thomas Hess: Software Mentor
- Anadarko: Providing seismic data
- Dr. Carlos: Providing well logs data
- Mom and Dad

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